Verification Statement For Translation

I, Jung-Hyun KIM, hereby declare that I am conversant in the Korean and the English languages and that I am the translator of the document attached and certify that to the best of my knowledge and belief the following is a true and correct English translation of the specification contained in Korean Patent Application No. 10-2003-0023090 filed on April 11, 2003.

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【Abstract of the disclosure】

【Abstract】

A plasma display panel according to the present invention can minimize the rupture of barrier ribs due to external load by increasing the structural intensity of edges portion thereof. The plasma display panel includes a first substrate and a second substrate spaced apart from each other at a distance and proceeding substantially parallel to each other, the first substrate and the second substrate having a display area and a non-display area, a plurality of address electrodes formed on the first substrate and covered by a dielectric layer, barrier ribs arranged at the display area between the substrates to form discharge spaces, phosphor layer formed within the discharge spaces, a plurality of discharge sustain electrodes formed on the surface of the second substrate facing the first substrate and covered by a dielectric layer, and reinforcing barrier ribs arranged at the non-display area while surrounding the display area, and having at least an outer structure curved toward the non-display area.

【Representative drawing】

FIG. 1

【Keyword】

Plasma display, Plasma Display Panel (PDP), Barrier rib, Discharge cell, Reinforcing barrier rib, Address electrode, Discharge sustain electrode

【Specification】

【Title of the invention】

DISPLAY DEVICE USING PALSMA DISPLAY PANEL

【Brief description of the drawings】

Fig. 1 is a partial exploded perspective view of a PDP according to an embodiment of the present invention.

Fig. 2 is a partial combined sectional view of the PDP taken in the direction of the arrow A of Fig. 1.

Fig. 3 is a plan view of the PDP according to the embodiment of the present invention.

Fig. 4 schematically illustrates main barrier ribs and reinforcing barrier ribs for the PDP shown in Fig. 1.

Fig. 5 is an exploded perspective view of a display device using the PDP according to the embodiment of the present invention.

Fig. 6 schematically illustrates a first variation of the PDP according to the embodiment of the present invention.

Fig. 7 is a partial sectional view of the PDP according to the embodiment of the present invention, schematically illustrating a second variation thereof.

Fig. 8 schematically illustrates main barrier ribs of a third variation of the PDP according to the embodiment of the present invention.

Fig. 9 schematically illustrates main barrier ribs of a fourth variation of

the PDP according to the first embodiment of the present invention.

[Detailed Description of the Invention]

[Object of the Invention]

[Field of the Invention and Description of Related Art]

The present invention relates to a plasma display panel, and in particular, to a plasma display panel with barrier ribs defining discharge cells and with reinforcing barrier ribs preventing the rupture of the barrier ribs or substrates by external load.

Recently, a plasma display panel (hereinafter referred to as a "PDP") has been spotlighted as a candidate for a wide screen display devices, such as a wall-mounted TVs and others. The PDP performs its displaying operation with a discharge mechanism realized at discharge cells. The discharge cells are formed by barrier ribs placed on the substrates in a suitable pattern (stripe or lattice).

As is well known in the art, the PDP is supported by a chassis base mounting a plurality of driving circuit boards at its rear side, and a front cabinet and a back cover are arranged at the front and the back of the PDP and chassis base, respectively. The front cabinet and the back cover are combined with each other in a body while interposing the PDP and the chassis base, thereby forming the outer structure of the display device.

The PDP-oriented display device has the advantages of a thin-thickness, and a light weight. However, when the display device undergoes impact or vibration of external loading, the PDP is liable to be bent or twisted, and this exhibits a structural weakness thereof.

With the PDP display device, the chassis base endures most of the loads and the distortions pursuant thereto, but is limited in its structural intensity. When an excessive external load is applied to the display device, the chassis base does not disperse it in a suitable manner.

The excessive external load reaches the PDP, and particularly the barrier ribs mounted within the PDP, so that the substrates or the barrier ribs are broken or ruptured. In this case, the broken fractions of the substrates or the barrier ribs float in the PDP, and are introduced into the discharge cells, thereby interrupting or stopping the discharge operation within the relevant discharge cells. The resulting abnormal discharge can break the dielectric, causing device failure.

[Technical Subject of the Invention]

According to an aspect of the present invention, a display device is provided which can enhances its structural intensity and minimizes damage due to external loading, i.e., bending, twisting, impact, and vibration

[Detailed Description]

The present invention provides a display device including a first substrate and a second substrate spaced apart from each other at a distance and proceeding substantially parallel to each other, the first substrate and the second substrate having a display area and a non-display area, a plurality of address electrodes formed on the first substrate and covered by a dielectric layer, main barrier ribs arranged at the display area between the substrates to form discharge spaces, phosphor layer formed within the discharge spaces, a plurality of discharge sustain electrodes formed on the surface of the second

substrate facing the first substrate and covered by a dielectric layer, and reinforcing barrier ribs arranged at the non-display area while surrounding the display area, and having at least an outer structure curved toward the non-display area.

Preferably, the reinforcing barrier ribs surround all four edges of the display area, and the thickness of the reinforcing barrier ribs is substantially the same as the thickness of the main barrier ribs.

The reinforcing barrier ribs are outlined with an arc, and a curvature center of the arc is directed toward the display area. Alternatively, the reinforcing barrier ribs are outlined with a plurality of arcs with different curvature centers.

In the latter case, the arc portions of the reinforcing barrier ribs are differentiated in the thickness thereof. The arc portion with a relatively small dimension is smaller than that of main barrier rib, thereby enhancing exhaustion efficiency.

The reinforcing barrier ribs are outlined with a plurality of arc portions with different curvature centers. In this case, the respective arc portions of the reinforcing barrier ribs correspond to the respective discharge spaces formed by the main barrier ribs. Alternatively, the respective arc portions of the reinforcing barrier ribs correspond to two or more discharge spaces formed by the main barrier ribs.

The detailed description of an exemplary embodiment of the present invention will be explained referring to the attached drawings.

Fig. 1 is a partial exploded perspective view of a PDP according to an

embodiment of the present invention, and Fig. 2 is a partial combined sectional view of the PDP taken in the direction of the arrow A of Fig. 1.

Referring to Figs. 1 and 2, PDP 2 has first transparent substrate 4 and second transparent substrate 6 spaced apart from each other with some distance while proceeding substantially parallel to each other, and has a discharge mechanism disposed between the two substrates to make the displaying operation.

Specifically, a plurality of address electrodes 10 are formed on first substrate 4 with a stripe pattern and are covered by dielectric layer 8.

Discharge sustain electrodes 14 are formed on the surface of second substrate 6 facing first substrate 4 with a stripe pattern while proceeding parallel to each other. Discharge sustain electrodes 14 cross over the address electrodes 10, and are covered by transparent dielectric layer 12. Discharge sustain electrodes 14 are formed with a transparent material, such as indium tin oxide (ITO).

Transparent protective layer 16 is formed on transparent dielectric layer 12 with MgO. A plurality of barrier ribs 18 are disposed between first substrate 4 and second substrate 6. The barrier ribs 18 are arranged between address electrodes 10 while proceeding parallel thereto. Red (R), green (G), and blue (B) phosphor layers 20 are formed on the lateral sides of the barrier ribs 18 and the top surface of dielectric layer 8.

The barrier ribs 18 are formed with a stripe pattern, but the pattern of barrier ribs 18 is not limited thereto. For instance, the barrier ribs 18 may be formed with a lattice pattern.

The space between barrier rib neighbors 18 is operated as a discharge space, and a discharge gas (not shown) is injected into the discharge space to form discharge cell 22. Hereinafter, the barrier ribs defining the discharge cell 22 are referred to as "main barrier ribs". In this case, referring to Figs. 2 and 3, the main barrier ribs 18 are placed within display area 24 defined on first substrate 4 and second substrate 6.

In addition to main barrier ribs 18, PDP 2 further has reinforcing barrier ribs 28 formed at non-display area 26 with no discharge cell, while surrounding at least an edge of display area 24. In addition, reinforcing barrier ribs 28 are formed in shape of arc with the outer structure curved toward the non-display area 26, thereby increasing structural intensity of the PDP 2.

Reinforcing barrier ribs 28 may surround any one edge or two opposite edges of display area 24, or all the four edges thereof. The structure where reinforcing barrier ribs 28 surround all the four edges of display area 24 will be now explained in detail.

Fig. 4 schematically illustrates the main barrier ribs and the reinforcing barrier ribs. In this embodiment, reinforcing barrier ribs 28 surround the four edges of display area 24 where main barrier ribs 18 are arranged, and are closely adhered to main barrier ribs 18 at non-display area 26.

Reinforcing barrier ribs 28 may include horizontal reinforcing barrier ribs 28A proceeding in the direction of the long axis of the first and the second substrates (in the X direction of the drawing), and vertical reinforcing barrier ribs 28B proceeding in the direction of the short axis of the first and the second substrates (in the Y direction of the drawing). Horizontal reinforcing barrier ribs

28A are closely adhered to both end portions of main barrier ribs 18 while proceeding perpendicular to main barrier ribs 18. Vertical reinforcing barrier ribs 28B are closely adhered to outermost barrier ribs 18a while proceeding parallel thereto.

Horizontal and vertical reinforcing barrier ribs 28A, 28B are formed with the same thickness, which is identical with that of main barrier rib 18.

On the other hand, the width of horizontal reinforcing barrier ribs 28A and vertical reinforcing barrier ribs 28B is largest at the center thereof, and is gradually reduced as they proceed toward the peripheries thereof. This is because when the width of the horizontal and vertical reinforcing barrier ribs 28A, 28B is differentiated in the longitudinal direction thereof, with the application of the external loading to the periphery of display area 24, reinforcing barrier ribs 28 can disperse the external loading more effectively. Accordingly, the respective horizontal and vertical reinforcing barrier ribs 28A, 28B substantially forming reinforcing barrier ribs 28 have an outer structure directed toward the non-display area 26 and formed in shape of an arc with a curvature.

When main barrier ribs 18 are formed on first substrate 4 using a screen printing technique, reinforcing barrier ribs 28 may be formed together with the same material.

As seen in Fig. 1, PDP 2 with reinforcing barrier ribs 28 is formed as a display panel where first substrate 4 and second substrate 6 are aligned and sealed to each other by frit 30 at their peripheries. As shown in Fig. 5, PDP 2 is fitted to chassis base 32 mounting a plurality of driving circuit boards thereon.

Front cabinet 34 and back cover 36 are arranged at the front and the back of PDP 2 and chassis base 32 and combined with each other in a body.

With the above-structured PDP 2, an address voltage Va is applied between address electrode 10 and any one of the discharge sustain electrodes (Y electrode) to select discharge cell 22, and a sustain voltage Vs is applied to a pair of the discharge sustain electrodes (X and Y electrodes) to induce plasma discharge within discharge cell 22 and excite phosphor film 20 at the relevant discharge cell, thereby displaying the desired images.

In case the display device is under external loading from the outside, such as bending, twisting, impact, and vibration, the load is primarily absorbed by chassis base 32, and the residue thereof not absorbed by chassis base 32 is absorbed by reinforcing barrier ribs 28. That is, the periphery of PDP 2 where the external load is concentrated is reinforced by reinforcing barrier ribs 28 so that it can completely absorb the external load, thereby preventing main barrier ribs 18 from being broken. The specific experimental results related thereto will be later explained with reference to Tables 1 and 2.

Variations of the PDP according to the embodiment of the present invention will be now explained with reference to Figs. 6 to 9.

Fig. 6 illustrates a first variation of the PDP, which basically has the previously-described structure. With this variation, the horizontal and the vertical reinforcing barrier ribs 28A, 28B involve an outer structure having two or more arcs with different curvature centers, not a single arc with a curvature center.

When the horizontal and vertical reinforcing barrier ribs 28A, 28B are

outlined with two or more arcs, they effectively disperse the external load applied to PDP 2, thereby serving to heighten the structural intensity of PDP 2.

Fig. 7 illustrates a second variation of the PDP, which basically has the structure related to the first variation. With the horizontal or vertical reinforcing barrier ribs 28A, 28B, for the convenience in explanation, the arc portions differentiated in the curvature center are classified into first and second sub-reinforcing barrier ribs 38, 40 with different thickness.

Preferably, the thickness of the sub-reinforcing barrier rib (for instance, second sub-reinforcing barrier rib 40) with a relatively large dimension is substantially the same as that of main barrier rib 18, and the thickness of the sub-reinforcing barrier rib (for instance, first sub-reinforcing barrier rib 38) with a relatively small dimension is smaller than that of main barrier rib 18.

According to the second variation of the PDP, the sub-reinforcing barrier rib (for instance, first sub-reinforcing barrier rib 38) with a relatively small dimension partially opens discharge cell 22 formed by main barrier ribs 18. With this structure, when PDP 2 is internally exhausted, the exhaustion efficiency can be enhanced with the opening.

Fig. 8 illustrates a third variation of the PDP, which basically has the previously-described structure. With this variation, horizontal and vertical reinforcing barrier ribs 28A, 28B have a plurality of arc portions 42, 44 with different curvature centers, and arc portions 42, 44 have widths nV and widths nH, respectively.

Particularly, respective arc portions 42 forming horizontal reinforcing barrier rib 28A correspond to discharge cells 22 formed by main barrier ribs 18

one to one, or as shown in Fig. 9, corresponds to one or more discharge cells 22, for instance, three R, G, and B discharge cells 22.

According to the third variation, when the external loading is applied to PDP 2, respective arc portions 42, 44 forming horizontal and vertical reinforcing barrier ribs 28A, 28B disperse the external load more effectively to thereby enhance the structural intensity of PDP 2.

Table 1 lists the bending experiment results with respect to the PDP and the chassis base combined with each other. In Table 1, the Comparative Example concerns the PDP with no reinforcing barrier rib, Examples 1 to 5 the PDPs with the reinforcing barrier ribs related to the embodiment of the present invention, and Examples 6 to 10 the PDPs with the reinforcing barrier ribs related to the third variation of the embodiment of the present invention. The Comparative Example and the Examples all utilize the same chassis base.

In Table 1, the values nV, nH of the Examples 1 to 5 indicate the central widths of horizontal and vertical reinforcing barrier ribs 28A, 28B, as shown in Fig. 4. The values nV, nH of the Examples 6 to 10 indicate the widths of arc portions 42, 44 forming horizontal and vertical reinforcing barrier ribs 28A, 28B, as shown in Fig. 8.

Furthermore, in Table 1, the breakage load indicates the force applied to the center of the chassis base up to the breakage of the PDP and the chassis base, and the deflection indicates the maximum deflection degree when the PDP and the chassis base are broken due to the breakage load.

Table 1

	nV (mm)	nH (mm)	Breakage load (kg)	Deflection (mm)
Comparative Example	0	0	35.55	0.807
Example 1	5	5	38.77	1.106
Example 2	10	10	42.10	1.609
Example 3	30	30	56.55	2.222
Example 4	50	50	65.12	3.530
Example 5	70	70	70.55	4.200
Example 6	5	5	45.66	1.702
Example 7	10	10	50.01	2.201
Example 8	30	30	62.25	2.658
Example 9	50	50	70.05	4.230
Example 10	70	70	77.00	5.020

As listed in Table 1, compared to the PDP with no reinforcing barrier rib according to the Comparative Example, the PDPs with reinforcing barrier ribs according to the Examples 1 to 5 involved the breakage load increased maximally by 1.98 times and the deflection increased maximally by 5.2 times, and the PDPs with reinforcing barrier ribs according to the Examples 6 to 10 involved the breakage load increased maximally by 2.17 times, and the deflection increased maximally by 6.22 times.

In view of the experimental results, it is confirmed that the structural intensity of the PDP according to the embodiment of the present invention is

reinforced by the reinforcing barrier ribs, and the endurance thereof against the bending load is strengthened. Particularly, it can be seen that the reinforcing barrier ribs related to the third variation are very advantageous in reinforcing the intensity of the PDP against the bending load.

Table 2 lists the twisting experiment results with respect to the PDP and the chassis base. The conditions for the Comparative Example, the Examples 1 to 5 and the Examples 6 to 10 were the same as those related to the previously-described bending experiment. The twisting experiment was conducted through completely fixing the one-sided end portion of the assembly of the PDP and the chassis base, installing a ball bearing jig at the left edge of the opposite-sided end portion thereof, and applying a vertical twisting load to the right edge thereof.

In Table 2, the breakage load indicates the vertical load applied to the PDP and the chassis base up to the breakage thereof, and the deflection indicates the maximum deflection degree when the PDP and the chassis base are broken.

Table 2

	nV (mm)	nH (mm)	Breakage load (kg)	Deflection (mm)
Comparative Example	0	0	57.67	3.940
Example 1	5	5	61.72	4.577
Example 2	10	10	69.91	5.088
Example 3	30	30	75.55	5.618

Example 4	50	50	81.12	6.401
Example 5	70	70	89.32	7.011
Example 6	5	5	45.66	5.052
Example 7	10	10	74.66	5.516
Example 8	30	30	79.31	6.129
Example 9	50	50	90.55	7.068
Example 10	70	70	98.00	7.654

As listed in Table 2, compared to the PDP with no reinforcing barrier rib according to the Comparative Example, the PDPs with reinforcing barrier ribs according to the Examples 1 to 5 involved the breakage load increased maximally by 1.55 times and the deflection increased maximally by 1.78 times, and the PDPs with reinforcing barrier ribs according to the Examples 6 to 10 involved the breakage load increased maximally by 1.7 times, and the deflection increased maximally by 1.94 times.

In view of the experimental results, it is confirmed that the structural intensity of the PDP according to the embodiment of the present invention is reinforced by the reinforcing barrier ribs, and the endurance thereof against the twisting load is strengthened. Particularly, it can be seen that the reinforcing barrier ribs related to the third variation are very advantageous in reinforcing the intensity of the PDP against the twisting load.

Although exemplary embodiments of the present invention have been described in detail hereinabove, it should be clearly understood that many variations and/or modifications of the basic inventive concept herein taught

which may appear to those skilled in the art will still fall within the spirit and scope of the present invention, as defined in the appended claims.

[Effect of the Invention]

As described above, the structural intensity of the PDP according to the first embodiment of the present invention is reinforced by the reinforcing barrier ribs so that when an external loading, such as bending, twisting, impact, and vibration, is applied to the PDP, the breakage of the PDP like the collapsing of the barrier ribs can be minimized. Accordingly, even though the external load not absorbed by the chassis base is applied to the PDP, the breakage thereof can be prevented, and the discharge cells can be operated in a stable manner.

WHAT IS CLAIMED IS:

1. A display device in which a front cabinet and a back cover surround a plasma display panel and a chassis base and are combined each other, the plasma display panel comprising:

a first substrate and a second substrate spaced apart from each other at a distance and proceeding substantially parallel to each other, the first substrate and the second substrate having a display area and a non-display area;

a plurality of address electrodes formed on the first substrate and covered by a dielectric layer;

main barrier ribs arranged at the display area between the substrates to form discharge spaces;

phosphor layer formed within the discharge spaces;

a plurality of discharge sustain electrodes formed on the surface of the second substrate facing the first substrate and covered by a dielectric layer; and

reinforcing barrier ribs arranged at the non-display area while surrounding the display area, and having at least an outer structure curved toward the non-display area.

2. The display device of claim 1, wherein the reinforcing barrier ribs surround all four edges of the display area.

3. The display device of claim 1, wherein the thickness of the reinforcing barrier ribs is substantially the same as the thickness of the main barrier ribs.

4. The display device of claim 1, wherein the reinforcing barrier

ribs have a width gradually reduced from the center thereof to both end portions thereof.

5. The display device of claim 1, wherein the reinforcing barrier ribs are outlined with an arc, and a curvature center of the arc is directed toward the display area.

6. The display device of claim 1, wherein the reinforcing barrier ribs are outlined with a plurality of arcs with different curvature centers.

7. The display device of claim 6, wherein the arc portions of the reinforcing barrier ribs are differentiated in the thickness thereof.

8. The display device of claim 7, wherein an arc portion of the reinforcing barrier rib with the small thickness is thinner than the thickness of the main barrier rib.

9. The display device of claim 1, wherein the reinforcing barrier ribs are outlined with a plurality of arc portions with different curvature centers.

10. The display device of claim 9, wherein the respective arc portions of the reinforcing barrier ribs correspond to the respective discharge spaces formed by the main barrier ribs.

11. The display device of claim 9, wherein the respective arc portions of the reinforcing barrier ribs correspond to two or more discharge spaces formed by the main barrier ribs.